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Pasadena, California

AMSU Channel 4 Calibration

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AIRS Science Team Meeting; Pasadena, CA; April 15-18, 2008

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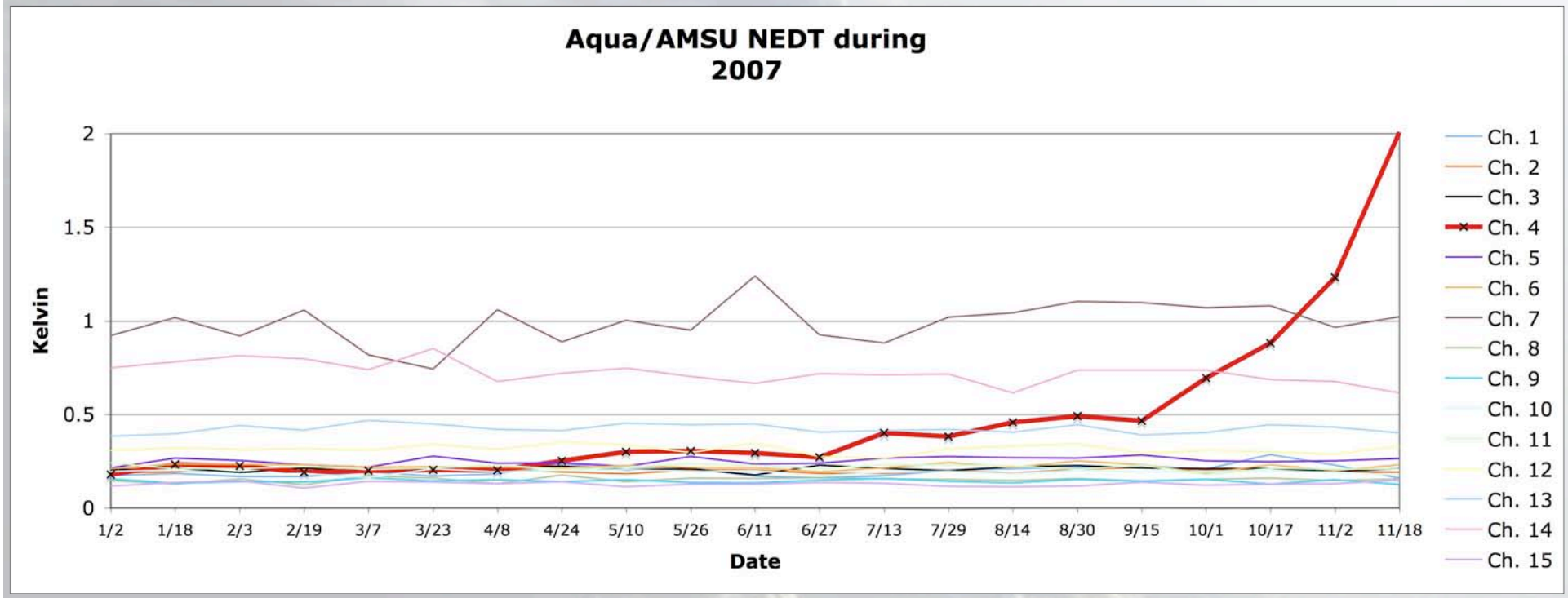
From Nov. 29 NetMeeting:

Ch. 4 Radiometric Noise Is Increasing



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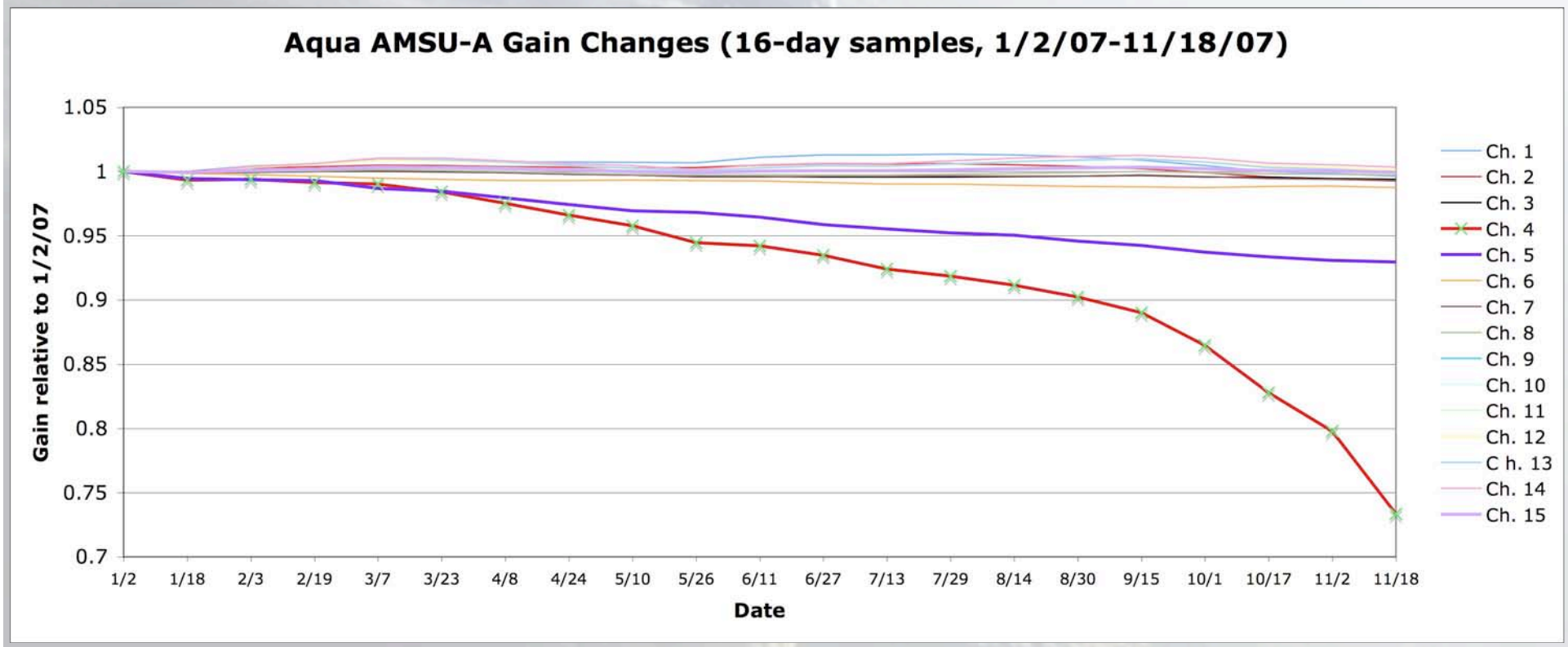
From Nov. 29 NetMeeting:

Ch. 4 Gain Is Decreasing



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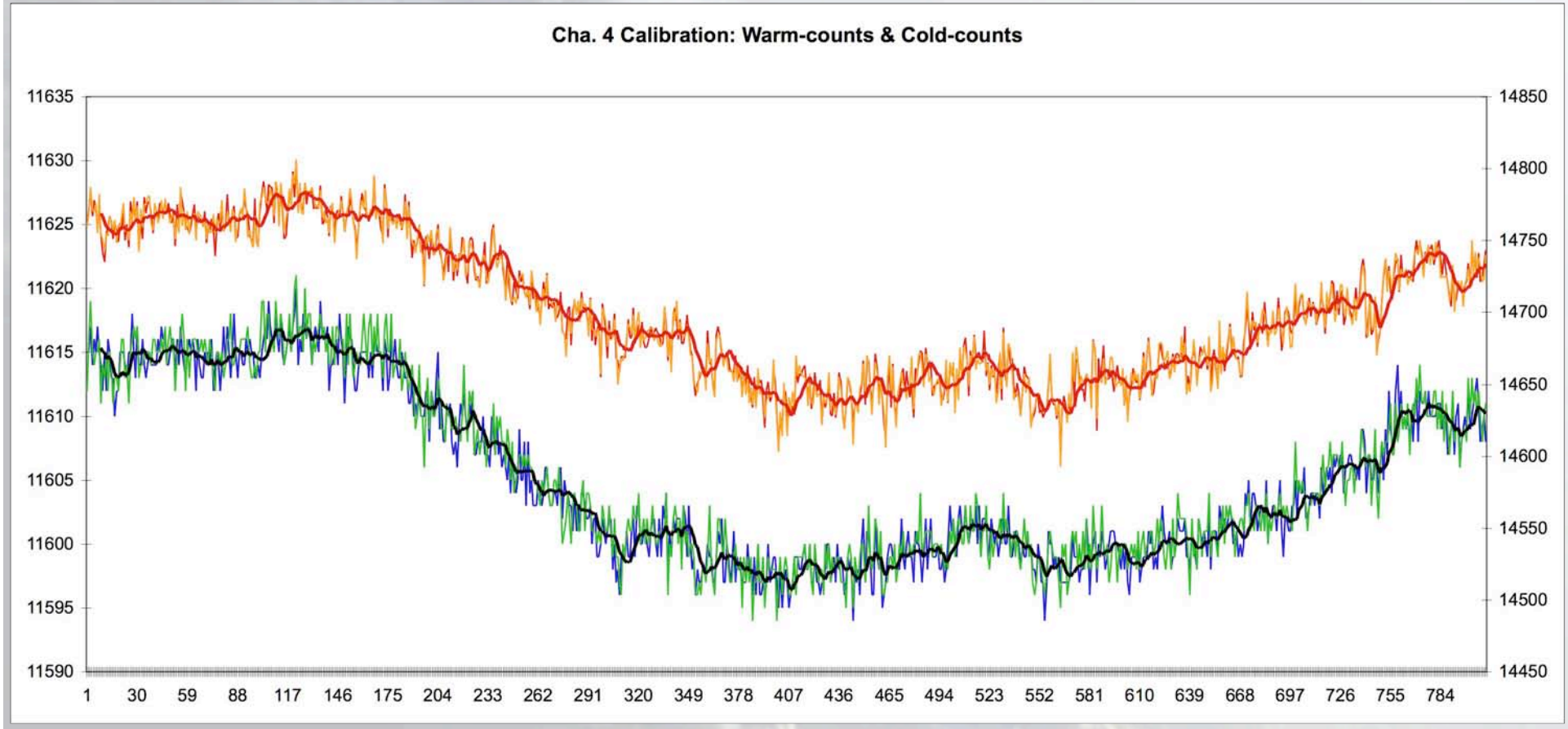
From Nov. 29 NetMeeting:

Strong orbital signal in both WC and CC



Tb image visual inspection suggests non-random behavior, but histogram analysis of calcounts indicates random (Gaussian) noise

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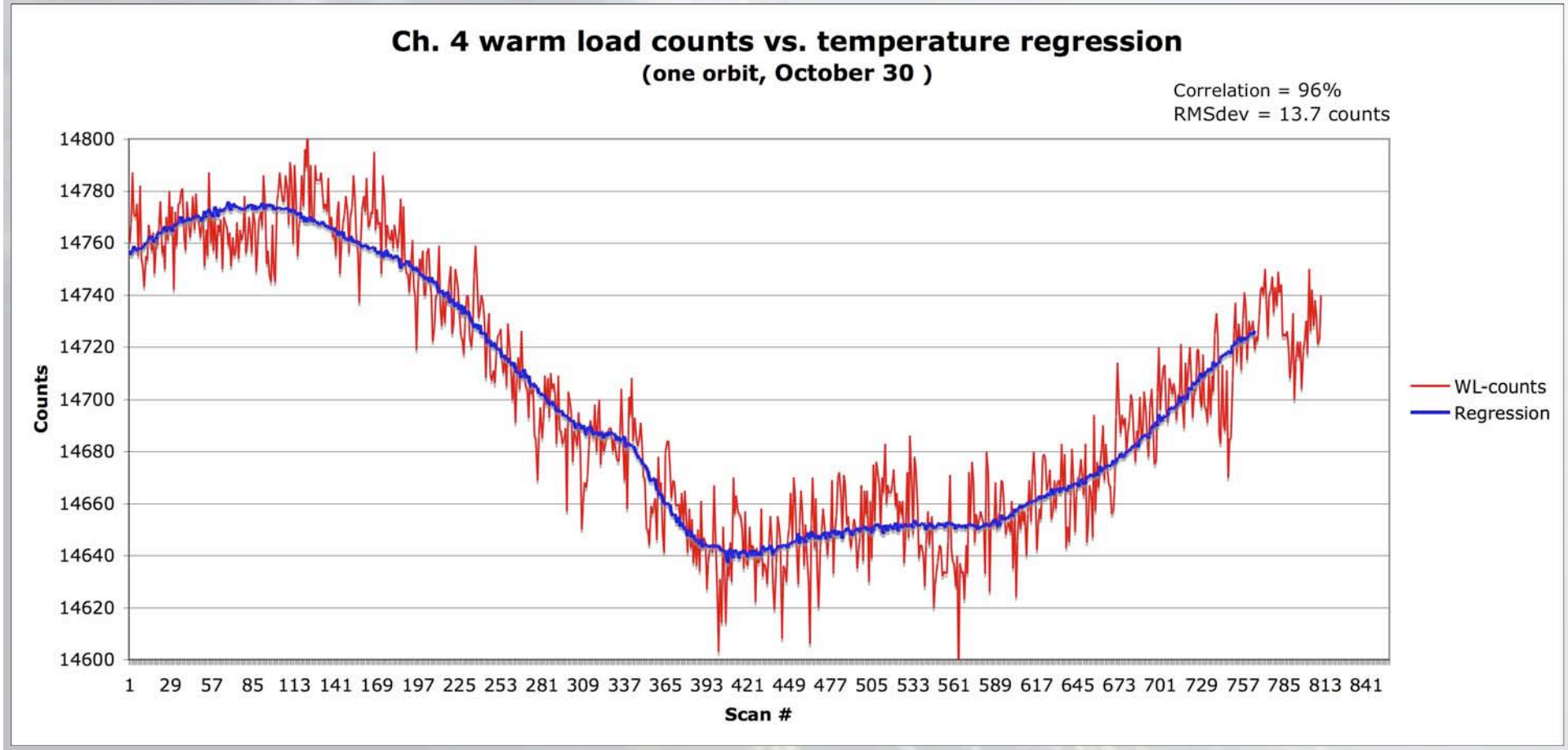
From Nov. 29 NetMeeting:

Variation "predicted" by 3 instrument T's



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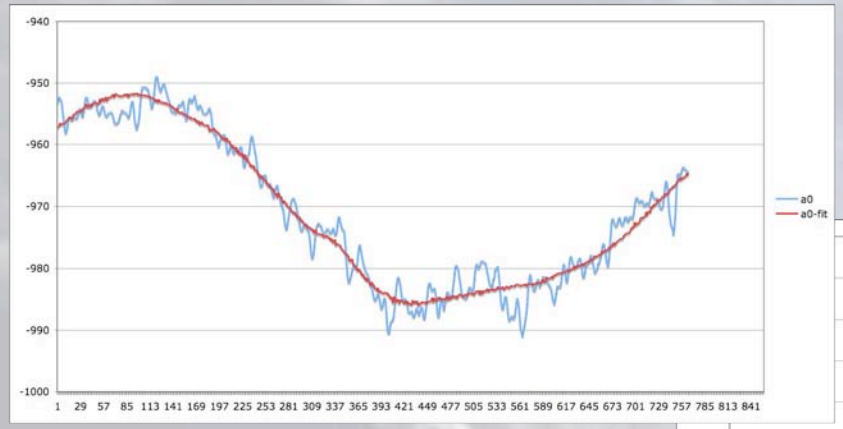
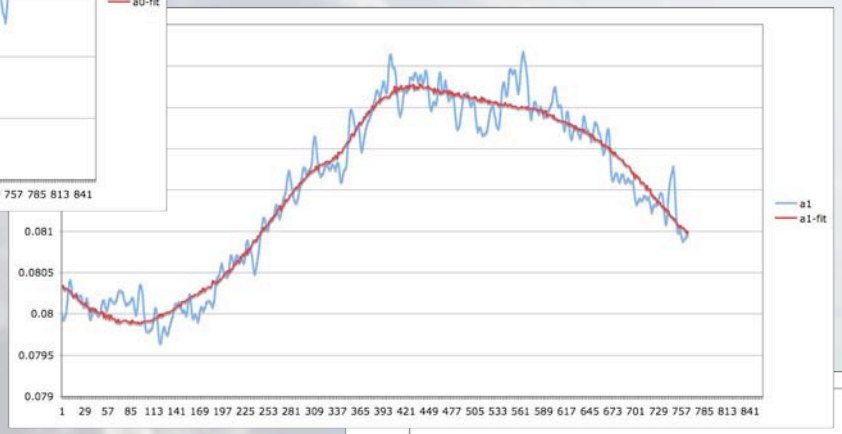
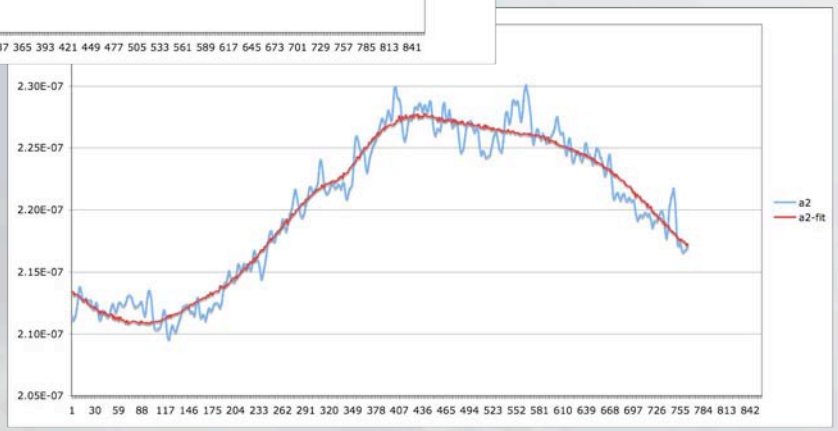
From Nov. 29 NetMeeting:

Regression fit of cal. coefficients







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Next step: Consult with manufacturer

- **NGES (formerly Aerojet) made some surprising analyses:**
  - ***Noise increase affects Warm-cal only***
  - ***Cold-cal and scene counts are nominal!***
- **NGES proposed explanation:**
  - ***Ch. 4 Mixer/IF-amp is likely at fault***
  - ***Uses diodes in balanced design***
  - ***If one of 2 diodes is degrading, the following would happen:***
    - Mixer becomes unbalanced
    - Gain goes down
    - LO isolation/rejection goes down
    - LO leaks through & is reflected from cal-target (but does not affect scene counts)
    - This would look like noise in warm-cal only
  - ***In contrast, IF low-pass filter failure would affect all counts***
- **If this is correct, a recovery is possible**
  - ***Warm-cal is only used to determine linear gain***
  - ***There are other methods that can be used instead***
- **NGES tried to develop "recovery" algorithm - Unsuccessful**
- **JPL also tried: See next slides**

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Recover Channel 4?

- **Alternative calibration algorithm considered by JPL:**
  - ***Gain determined by regression against instrument temperatures***
  - ***Method developed & tested by Thompson, Rogers & Davis***
    - "Temperature Compensation of Total Power Radiometers", *IEEE Trans. Microwave Theory Tech.*, **51**, 2073-2078 (2003)
- **This will work if**
  - ***Radiometer (receiver) is still linear***
  - ***Scene observations (Earth, space) are nominal***

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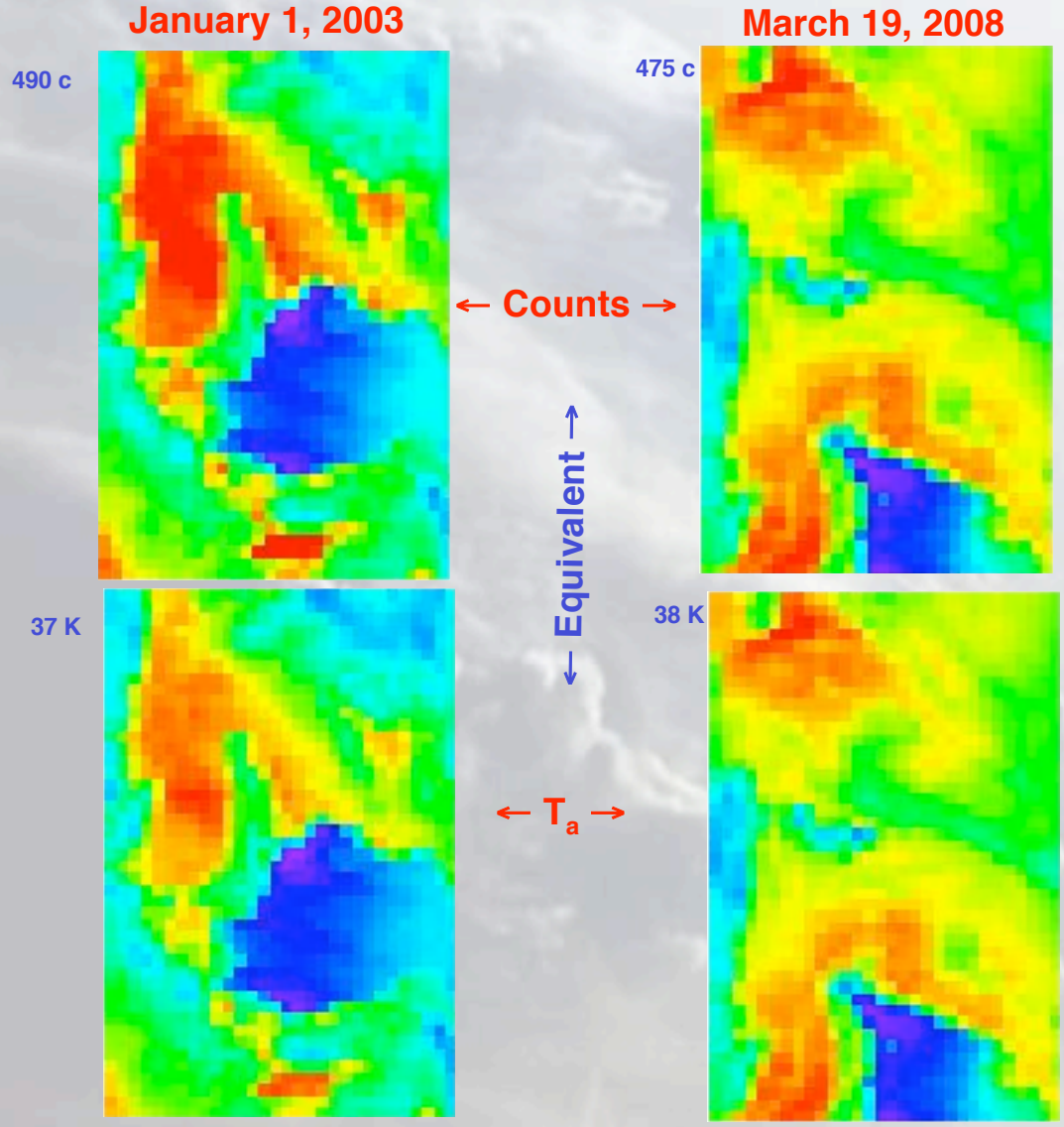
Normal channel (#3): Counts vs. T_a



T_a is linear function of counts:

$\Delta T_a = \Delta N/\text{gain}$

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However…

- **But, alas**
  - ***Assumptions do not hold***
    - Scene observations are also affected by hardware failure
    - Radiometer output is declining towards zero

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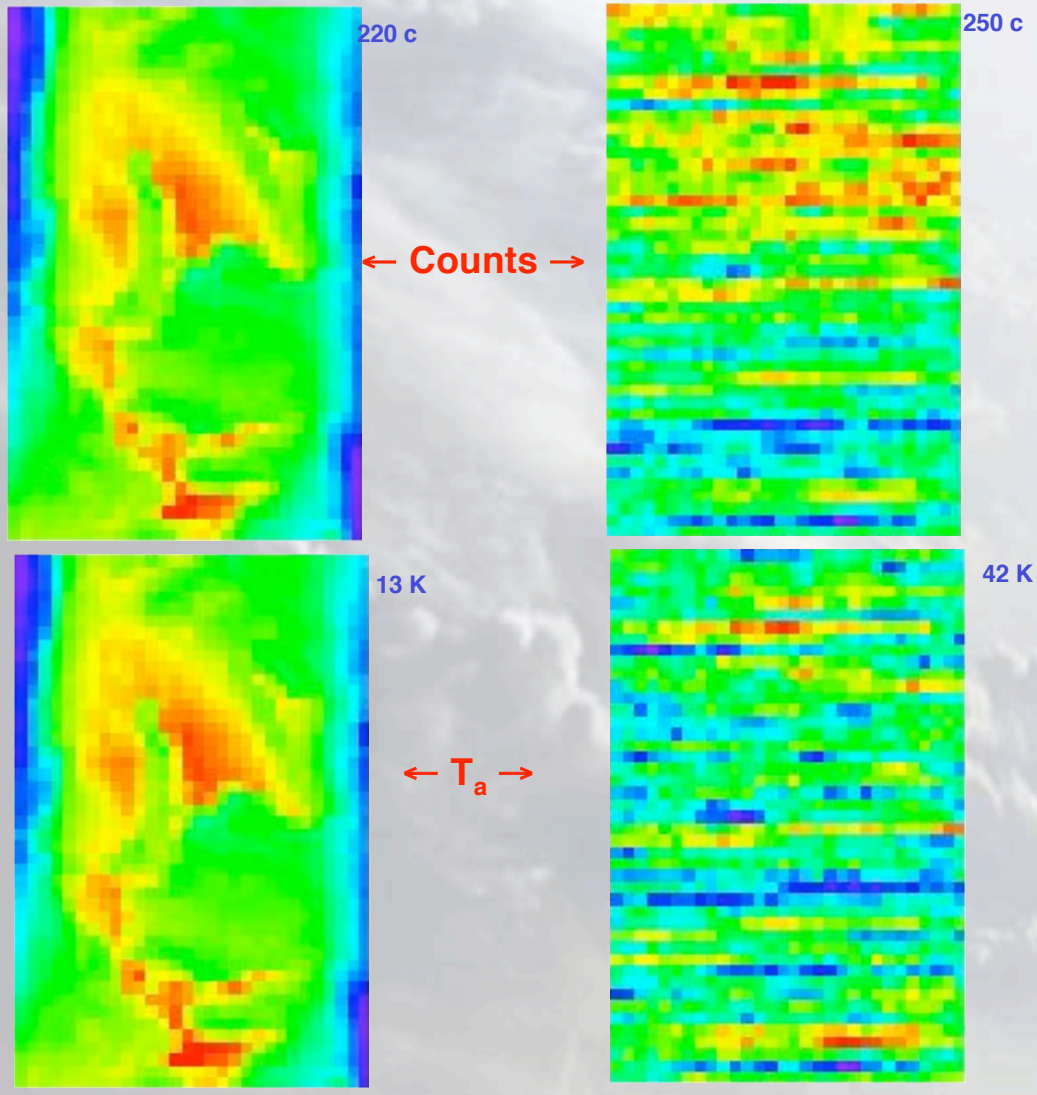
Bad channel (#4): Counts vs. T_a

January 1, 2003 | **March 19, 2008**



If hypothesis holds of
bad warm-cal
good receiver
then "scene counts"
should remain good

However: not so

Therefore:
Can't apply "good gain"

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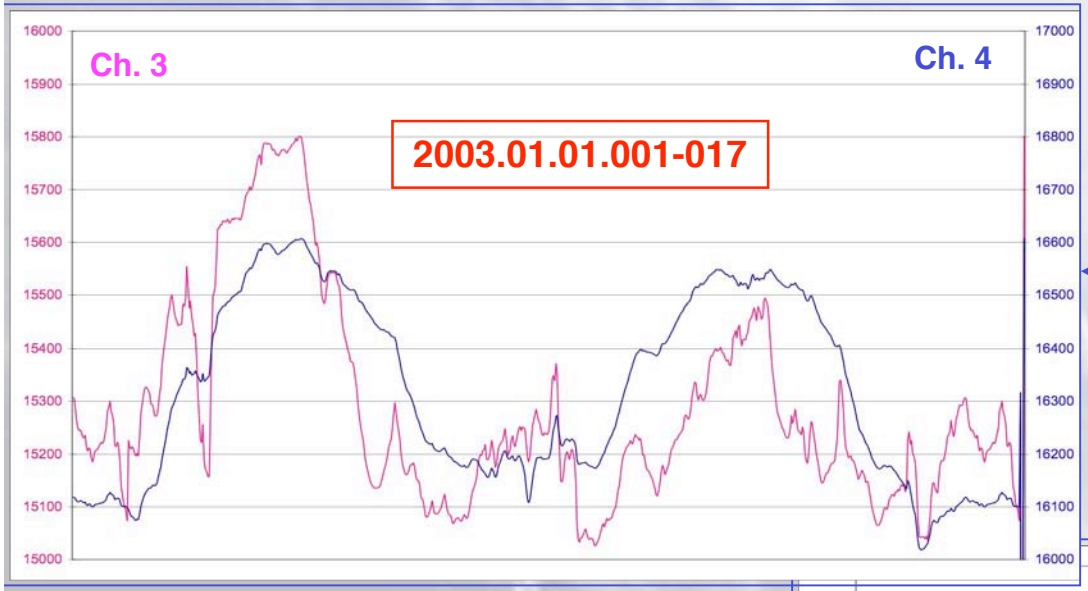
One orbit: 2003 vs. 2008; Ch.3 vs. Ch.4



Note drastic reduction in channel 4 output!

The dynamic range of Ch. 4 has gone down by an order of magnitude

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Conclusions

- **Channel 4 receiver output is both noisy & declining**
- **Δ(Warm-cal - Cold-cal) is down by an order of magnitude**

  3587 ± 2.9 in 2003 *<-- High output, low noise*

  409 ± 62 in 2008 *<-- Low output, high noise*

- **It is highly unlikely that recovery is possible**

- **It looks like Channel 4 is dying**

The S/W remedy is likely to remain the best solution